

AP Chemistry Unit 1 Test - Foundational Topics

Multiple choice

No calculators may be used

Note: For all question, assume that the temperatuer is 298K, the pressure is 1.00 atm, and solutions are aqueous unless otherwise specified

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

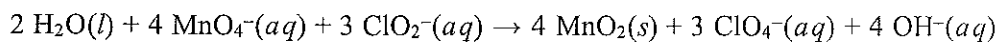
Isotope	Percent Abundance	Atomic Mass (amu)
C-12	98.93	12.0000
C-13	1.07	13.0034
C-14	1.00×10^{-10}	14.0032

1. Carbon has two naturally occurring isotopes and one radioactive isotope. The data for each isotope is shown above. Which of the following best represents the atomic mass of carbon?
- A) 12.000
B) 12.011
C) 13.022
D) 12.031
2. When hafnium metal is heated in an atmosphere of chlorine gas, the product of the reaction is found to contain 62.2 percent Hf by mass and 37.4 percent Cl by mass. What is the empirical formula for this compound?
- A) HfCl
B) HfCl_2
C) HfCl_3
D) Hf_2Cl_3
3. The mass of element Q found in 1.00 mole of each of four different compounds is 38.0 grams, 57.0 grams, 76.0 grams, and 114 grams, respectively. A possible atomic weight of Q is
- A) 12.7
B) 19.0
C) 27.5
D) 38.0

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4. According to the balanced equation above, how many moles of $\text{ClO}_2^-(aq)$ are needed to react completely with 20. mL of 0.20 M KMnO_4 solution?

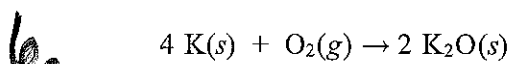
A) 0.0030 mol
B) 0.0053 mol
C) 0.0075 mol
D) 0.013 mol

5. The alkenes are compounds of carbon and hydrogen with the general formula C_nH_{2n} . If 3.50 gram of any alkene is burned in excess oxygen, what number of moles of H_2O is formed?

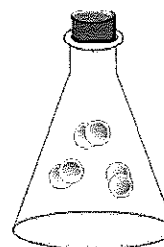
A) 0.250 mole
B) 0.375 mole
C) 0.500 mole
D) 2.50 mole

7. When a hydrate of X_2CO_3 ($MM = 106$) is heated until all the water is removed, it loses 54 percent of its mass. The formula of the hydrate is

A) $\text{X}_2\text{CO}_3 \cdot 7 \text{H}_2\text{O}$
B) $\text{X}_2\text{CO}_3 \cdot 5 \text{H}_2\text{O}$
C) $\text{X}_2\text{CO}_3 \cdot 3 \text{H}_2\text{O}$
D) $\text{X}_2\text{CO}_3 \cdot \text{H}_2\text{O}$



Under certain conditions potassium can react with oxygen in the air to form potassium oxide according to the reaction above. Which image best represents the amount of potassium required to completely react with all of the oxygen shown in the flask below?

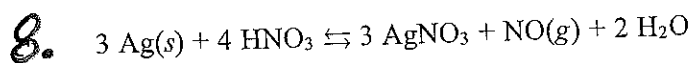


- A)
- B)
- C)
- D)

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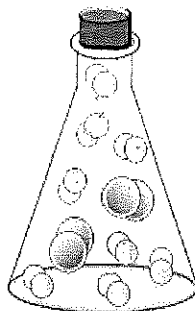
The reaction of silver metal and dilute nitric acid proceeds according to the equation above. If 0.10 mole of powdered silver is added to 10. milliliters of 6.0-molar nitric acid, the number of moles of NO gas that can be formed is

- A) 0.015 mole
- B) 0.020 mole
- C) 0.030 mole
- D) 0.045 mole

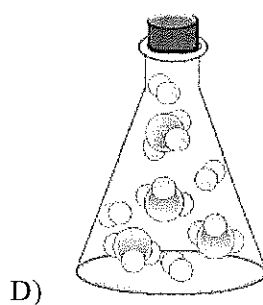
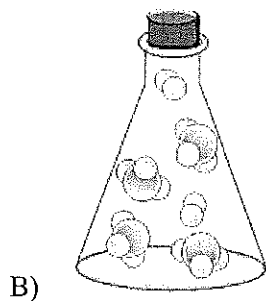
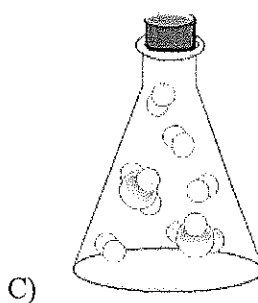
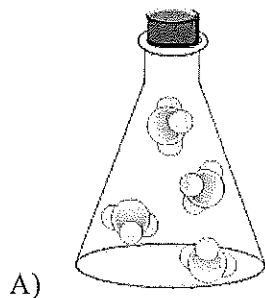
9. What number of moles of O_2 is needed to produce 142 grams of P_4O_{10} from P? (Molecular weight $\text{P}_4\text{O}_{10} = 284$)

- A) 0.500 mole
- B) 0.625 mole
- C) 1.25 mole
- D) 2.50 mole

10.



A flask contains a mixture of hydrogen and nitrogen as shown above. The temperature and pressure conditions are adjusted so that a maximum amount of ammonia, NH_3 , will form once the activation energy for the reaction has been exceeded. Which image below best represents the mixture in the flask after the reactants have reacted as completely as possible?



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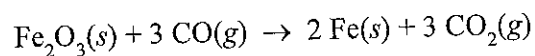
Free Response

YOU MAY USE YOUR CALCULATOR

Directions: Read each question carefully and write your response in the space provided following each question. Your responses to these questions will be scored on the basis of the accuracy and relevance of the information cited. Explanations should be clear and well organized. Specific answers are preferable to broad diffuse responses. For calculations, clearly show the method used and the steps involved in arriving at your answers. It is to your advantage to do this, since you may obtain partial credit if you do and you will receive little or no credit if you do not. Be sure to write all of your answers to the questions on the lined pages following the question set.

11. Answer the following questions that relate to chemical reactions.

- (a) Iron(III) oxide can be reduced with carbon monoxide according to the following equation.



A 16.2 L sample of $\text{CO}(g)$ at 1.50 atm and $200.^{\circ}\text{C}$ is combined with 15.39 g of $\text{Fe}_2\text{O}_3(s)$.

- (i) How many moles of $\text{CO}(g)$ are available for the reaction?
- (ii) What is the limiting reactant for the reaction? Justify your answer with calculations.
- (iii) How many moles of $\text{Fe}(s)$ are formed in the reaction?

12.

Tagatose is a new sweetener that may soon appear as an ingredient in some "lower calorie" foods for diabetics. It is used for these because it is 92% as sweet as sucrose (table sugar), contains only 38% as many calories per gram and does not increase blood sugar levels to any appreciable extent. Tagatose has a molar mass of 180.15 g/mol and analysis finds that it is 40.00% carbon, 6.73% hydrogen and 53.27% oxygen.

- a) Find the empirical formula for tagatose. b) Find the molecular formula for tagatose.